SUGGESTIONS FOR SOUTH CAROLINA AND THE COAST

Pursuant to the South Carolina Coastal Zone Act, the South Carolina Coastal Council (SCCC) was vested the authority to manage coastal development. SCCC gained authority over all land disturbing activities along coastal South Carolina pursuant to the Storm Water Management and Sediment Reduction Act of 1991, established in the South Carolina **State Register** June 26, 1992. The South Carolina Land Resource Conservation Commission (SCLRCC) was granted authority over all other land disturbing areas.

SCCC has published Storm Water Management Guidelines (September 1, 1988), Proposed Refinements to the Management Program Document, Certification Process (October 21, 1992), Regulations for Permitting in Critical Areas of the State's Coastal Zone (May 1991), and Guidelines and Policies of the South Carolina Coastal Management Program (NA-79-AA-D-CZ126). The SCCC also references the SCLRCC publications Erosion and Sediment Control Practices for Developing Areas (1985) and A Guide to Site Development and Best Management Practices for Storm Water Management and Sediment Control (1991). At the time, these documents were written using solid engineering judgement and more than adequate research to support their conclusions. In subsequent revisions of SCCC (1988), SCCC (1991), SCCC (NA-79-AA-D-CZ126), SCLRCC (1985), and SCLRCC

(1991), new and innovative designs (or practices) should be incorporated.

The innovations are available from research that the South Carolina Department of Health and Environmental Control (SCDHEC), SCCC, SCLRCC, and the Charleston Harbor Project has funded. If a committee could be formed that would share this combined research base, the most technically innovative, environmentally sound, and economically reasonable documents and guidelines could be drafted. The combining of some of these documents would allow design engineers and reviewers to have a single document to follow as a guide. This would produce better plans that were easier to review.

DESIGN AIDS

The following tables were created to aid in the selection of best management practices. Table II lists restrictions that are critical in choosing best management practices. Table III lists the relative benefits provide by best management practices. Table IV lists the comparative pollutant removal capabilities provided by best management practices. Table V lists relative environmental and community amenities provided by best management practices. Table VI provides basic design summaries for each best management practice.

Table II

Site Restrictions
on Urban Best Management Practices
(modified from Schueler 1987)

Best Management Practice	Slope	Water Table	Bedrock	Space Consumption	Maximum Depth	High Sediment Input	Thermal Impacts
Detention Pond	N	N	S	A	N	S	N
Retention Pond	N	N	S	A	A	S	A
Infiltration Basin	A	A	A	N	A	A	N
Infiltration Trench	S	A	A	S	A	A	N
Porous Pavement	A	A	A	A	A	A	N
Water Quality Inlet	N	N	A	N	A	A	N
Grassed Swale	A	A	S	N	N	A	N
Filter Strip	S	S	S	N	N	A	N

N = Generally not restrictive
S = Sometimes restrictive
A = Always restrictive

Table III

Comparative Storm Water Benefits Provided
by Urban Best Management Practices
(modified from Schueler 1987)

Best Management Practice	Control 2-yr. Storm	Control 10-yr. Storm	Control 100-yr. Storm	Volume Control	Groundwater Recharge	Streambank Erosion Control
Detention Pond	A	A	A	N	N	A
Retention Pond	A	A	A	N	N	A
Infiltration Basin	A	S	N	A	A	A
Infiltration Trench	A	S	N	A	A	A
Porous Pavement	A	S	N	A	A	A
Water Quality Inlet	N	N	N	N	N	N
Grassed Swale	S	N	N	S	S	N
Filter Strip	S	N	N	S	S	N

N = (Never) seldom beneficial
S = Sometimes beneficial
A = (Always) usually beneficial

Table IV

Relative Pollutant Removal of
Urban Best Management Practice Designs
(modified from Schueler 1987)

Best Management Practice	Suspended Sediments	Total Phos-phorus	Total Nitrogen	Oxygen Demand	Trace Metals	Bacteria	Overall Removal Capacity
Detention Pond Design 1/2/3	B/A/A	D/C/B	D/D/C	D/C/C	C/B/B	IK/IK/IK	M/M/H
Retention Pond Design 4/5/6	B/B/A	C/C/B	D/D/C	D/D/C	D/B/B	IK/IK/IK	M/M/H
Infiltration Basin Design 7/8/9	B/A/A	C/C/B	C/C/B	B/B/A	C/A/A	B/B/A	M/H/H
Infiltration Trench Design 7/8/9	B/A/A	C/C/B	C/C/B	B/B/A	B/A/A	B/B/A	M/H/H
Porous Pavement Design 7/8/9	C/A/A	B/B/B	C/B/B	B/B/A	C/A/A	B/A/A	M/H/H
Water Quality Inlet Design 10	E	IK	IK	IK	IK	IK	L
Grassed Swale Design 11/12	E/D	E/D	E/D	E/D	E/D	IK/IK	L/L
Filter Strip Design 13/14	D/A	E/C	E/C	E/B	D/A	IK/IK	L/M

E = 0-20% D = 20-40% C = 40-60% B = 60-80% A = 80-100% IK = Insufficient Knowledge
H = high M = moderate L = low

Note: Design numbers are described on the following page.

Notes for Table IV
(modified from Schueler 1987)

Design 1: First-flush runoff volume detained for 6-12 hours.
Design 2: Runoff volume produced by 1.0 inch, detained for 24 hours.
Design 3: Same as Design 2, but with shallow marsh in bottom stage.
Design 4: Permanent pool equal to 0.5 inch storage per impervious acre.
Design 5: Permanent pool equal to 2.5 times the mean storm runoff.
Design 6: Permanent pool equal to 4.0 times the mean storm runoff.
Design 7: Facility exfiltrates first-flush; 0.5 inch runoff/impervious acre.
Design 8: Facility exfiltrates one inch runoff volume per impervious acre.
Design 9: Facility exfiltrates all runoff, up to the 2 year design storm.
Design 10: 400 cubic feet of wet storage per impervious acre.
Design 11: High slope swales with no check dams.
Design 12: Low gradient swales with check dams.
Design 13: 20 foot wide turf strip.
Design 14: 100 foot wide forested strip with level spreader.

Table V

Environmental and Community Amenities
Provided by Urban Best Management Practices
(Source: Schueler)

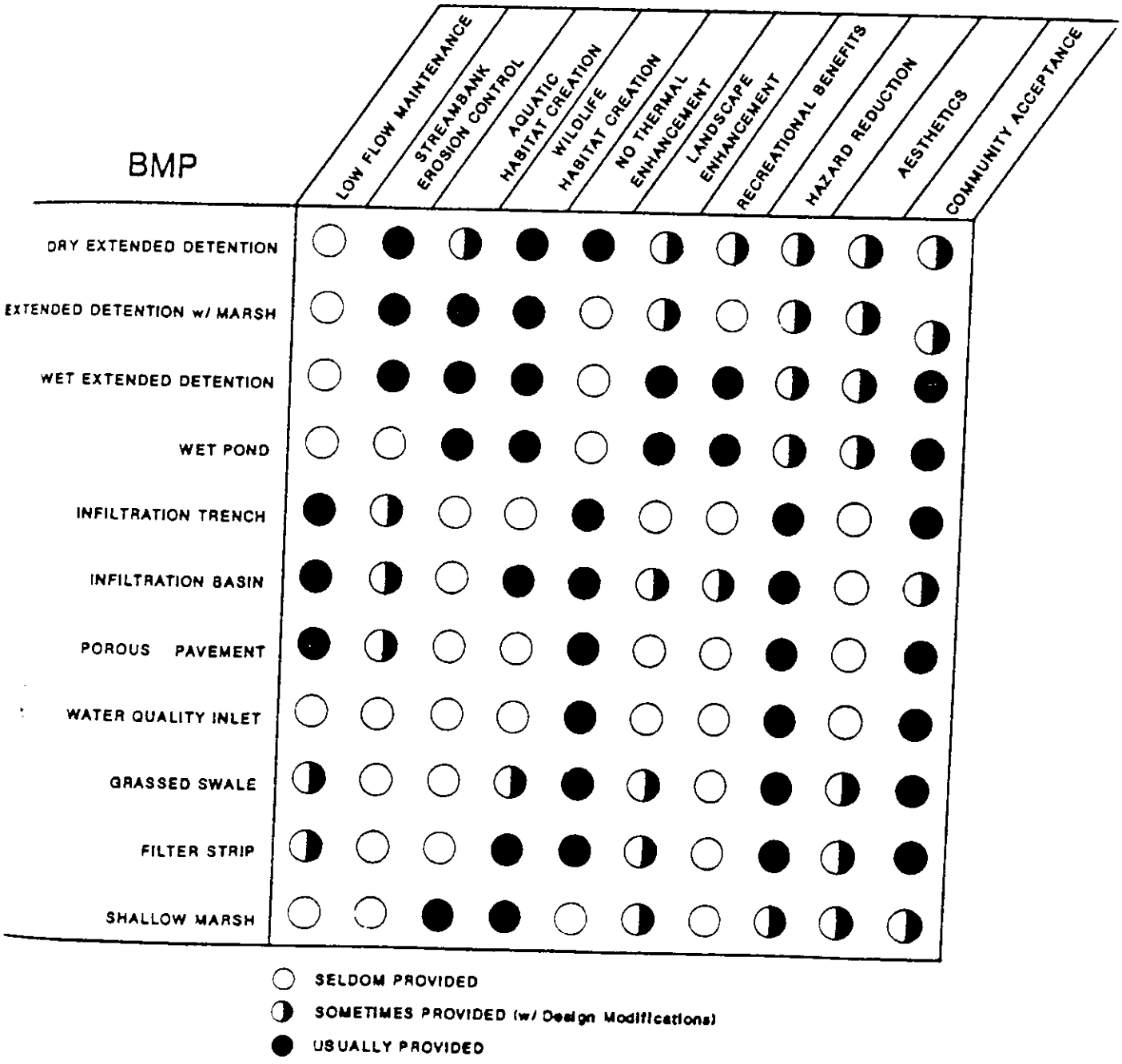

Table VI

Design Summary
of Urban Best Management Practices

Best Management Practice	Area Served (Acres)	Soil Type (Infiltration rate) (in/hr)	Depth to Water Table (ft)	Recommended Minimum/ Maximum Storage time (hrs.)	Slope	Typical Design Method
Detention Pond						
Retention Pond						
Infiltration Basin						
Infiltration Trench						
Porous Pavement						
Water Quality Inlet						
Grassed Swale						
Filter Strip						

*** To be filled in when more literature arrives.

BIBLIOGRAPHY

Adams, L. W., L. E. Dove, D. L. Leedy, and T. Franklin (1983), Methods for Storm Water Control and Wildlife Enhancement: Analysis and Evaluation, Urban Wildlife Research Center, Columbia, Maryland.

Anthanas, C. (1986), Wetland Basins for Storm Water Treatment: Analysis and Guidelines, Final Report, Maryland Department of Natural Resources, Horn Point Environmental Lab., Cambridge Massachusetts, UMCEES Reference Number TS-53-86.

Akan, A. Osman (1992), "Storm Runoff Detention for Pollutant Removal", **ASCE Journal of Environmental Engineering** Vol. 118, No. 3, May/June 1992.

American Public Works Association (**APWA** 1991), Water Quality: Urban Runoff Solutions, The APWA Research Foundation: May 1991.

Barfield, B. J. (1977), E. W. Tollner, and John C. Hayes, Prediction of Sediment Transport in Grassed Media, Transactions of American Society of Agricultural Engineers (ASAE) Paper Number 77:2023, St. Josephs, MO.

Barfield, B. J., R. C. Warner, and C. T. Haan (1981), Applied Hydrology and Sedimentology For Disturbed Areas, Oklahoma Technical Press, Stillwater, OK: 1981.

Barfield, B. J., C. T. Haan, and J. C. Hayes (1992), Applied Hydrology and Sedimentology for Small Catchments, Pre-publication Draft Copy: 1992.

Baxter, E. H. (1985), G. Mulamoottil, and D. Gregor, A Study of Residential Storm Water Impoundments: Perceptions and Policy Implications, Water Resources Bulletin.

Bedient, Philip B., and Wayne C. Huber (1992), Hydrology and Floodplain Analysis, 2nd Edition, Addison-Wesley Publishing Company, Reading Massachusetts: 1992.

Black, Peter E. (1991), Watershed Hydrology, Prentice Hall, Englewood Cliffs, New Jersey: 1991.

Chapman, Steven R. (1992), Lecture Notes, Agricultural Law and Related Environmental Issues, Summer of 1992, Clemson University, Clemson SC.

Chow, V. T., Open Channel Hydraulics, McGraw-Hill Book Company, New York: 1959.

Delaware Estuary Program (DEP 1992), "Nonpoint Source Pollution in the Delaware Estuary", Number 7, Winter 1992.

Dillaha, Theo A. (1986), J. H. Shephard, and D. Lee, Long Term Effectiveness and Maintenance of Vegetated Filter Strips, Virginia Water Resources Research Center. Bulletin Number 153, Blacksburg Virginia.

Dillaha, Theo A., and John C. Hayes (1992), Vegetative Filter Strips: II. Application of Design Procedures, American Society of Agricultural Engineers (ASAE) Paper Number 92-2103.

Free, B. M., and G. C. Mulamootil (1983), The Limnology of Lake Wabukayne: A Storm Water Impoundment, Water Resources Bulletin.

Freeze, R. Allen (1979), and John A. Cherry, Groundwater, Prentice Hall, Englewood Cliffs, New Jersey: 1979.

French, Richard H.(1985), Open-Channel Hydraulics, McGraw-Hill Book Company, New York: 1985.

Galli, J. (1986), Differences in Riffle Macroinvertebrate Community Structure Upstream and Downstream of an Urban Storm Water Management Pond, Master's Thesis, George Mason University.

George Thomas, S. (1992), American Society of Civil Engineers (ASCE), **ASCE Water Forum 1992**, Environmental Engineering Division, "Regional Planning for Storm Water Management".

Hayes, John C., and Theo A. Dillaha (1992), Vegetative Filter Strips: I. Site Suitability and Procedures, American Society of Agricultural Engineers (ASAE) Paper Number 92-2102.

Hayes, John C. (1990), "Erosion and Sediment Control Using Non-Structural Materials", A Report Submitted to SC LRCC, Clemson University: December 18, 1990.

Kercher, W. C. (1983), J. C. Landon, and R. Massarelli, Grassy Swales Prove Cost-Effective for Water Pollution Control, **Public Works**.

Klaine, Steve, "Optimization of Sampling Strategy to Assess Agricultural Nonpoint Source Pollutant Loading," A Report Submitted to the Water Environment Research Foundation, Clemson University: 1992.

Lakatos, D. E. and L. S. McNemar (1986), Storm Water Quality Using Wetlands, Walter B. Satterthwaithe Associates.

Lazaro, Timothy R. (1990), Urban Hydrology: A Multidisciplinary Perspective, Technomic, Lancaster: 1990.

Maryland Soil Conservation Service (**MD SCS** 1983), Maryland Specifications for Soil Erosion and Sediment Control, Maryland Water Resources Administration, Annapolis Maryland.

Maryland Water Resource Administration (**MD WRA** 1986), Minimum Water Quality and Planning Guidelines for Infiltration Practices, Maryland Department of Natural Resources, Annapolis Maryland.

Martin, James L., and Steve C. McCutcheon (1993), Principles of Hydraulics and Hydrodynamics For Water Quality Modeling, Pre-publication Draft Copy: December 1991.

McEnroe, Bruce, (1992) American Society of Civil Engineers (**ASCE**), **ASCE Water Forum 1992**, Hydraulic Engineering Division, "Sizing Storm Water Detention Reservoirs to Reduce Peak Flows".

Northern Virginia Planning District Commission (NVPDC 1979), Four Mile Run Flood Control Study. Prepared for the Metropolitan Washington Council of Governments.

Occoquan Watershed Monitoring Lab (OWML 1983), Final Contract Report: Washington Area NURP Project, prepared for Washington Council of Governments, Manassas, Virginia.

Phillips, Jonathan D. (1988), An Evaluation of the Factors Determining the Effectiveness of Water Quality Buffer Zones, **Journal of Hydrology**, 107 (1989), Elsevier Science Publishers B. V., Amsterdam - printed in The Netherlands.

Roberson, John A. (1988), John J. Cassidy, and M. Hanif Chaudhry, Hydraulic Engineering, Houghton Mifflin Company, Boston: 1988.

Rushton, Betty (1991), "Water Quality and Hydrologic Characteristics in A Wet Detention Pond," Southwest Florida Water Management District, Brooksville, FL: 1991.

Schueler, Thomas R. (1987), Controlling Urban Runoff: A Practical Manual For Planing and Designing Urban BMPs, Metropolitan Washington Council of Governments, Washington D.C.: 1987.

South Carolina Department of Health and Environmental Control (SCDHEC 1989 a), Bureau of Water Pollution Control, Assessment of Nonpoint Source Pollution For the State of South Carolina, October 1989.

SCDHEC (1989 b), Bureau of Water Pollution Control, Nonpoint Source Management Program For the State of South Carolina, October 1989.

South Carolina Land Resource Conservation Commission (SCLRCC 1992), A Guide to Site Development and Best Management Practices For Stormwater Management and Sediment Control, May 1992.

SCLRCC, "The Nonpoint Source Pollution Control Newsletter For South Carolina," Volume 1: Issue 1, Fall 1989 to present.

SCLRCC, "Storm Water Management and Sediment Reduction Regulations, R.72-300," The State (SC) Register, 26 June 1992.

Stahre, Peter and Ben Urbonas, Storm Water Detention: For Drainage, Water Quality, and CSO Management, Prentice Hall, Englewood Cliffs, New Jersey: 1990.

Traver, Robert G., (1992), American Society of Civil Engineers (**ASCE**), **ASCE Water Forum 1992,** Hydraulic Division, "Accumulation Effects of Storm Water Management Detention Basins".

United States Department of the Interior / Geological Survey (**USDI/GS**), "Water in the Urban Environment: Erosion and Sediment," The US Government Printing Office: 1981.

United States Environmental Protection Agency (**US EPA**), **EPA Journal - NPS Pollution**, Volume 17, Number 5, November/December 1991.

US EPA, "National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharges," The Federal Register 16 November 1990: 47990 - 48000.

US EPA (1983), Results of the Nationwide Urban Runoff Program: Volume 1 - Final Report, December, 1983.

US EPA (1990), Urban Targeting and BMP Selection: An Information and Guidance Manual for State Nonpoint Source Program Staff Engineers and Managers, Region V., Water Division, Chicago, IL.

Virginia Soil Conservation Service (VA SCS 1991), Virginia Erosion and Sediment Control Handbook.

Yousef, Y., Wanelista, M. and H. Harper (1985), Best Management Practices: Removal of Highway Contaminants by Roadside Swales, prepared for Florida Department of Highway Transportation, Tallahassee Florida.